A Multi-Label Classification Method for Anomaly Detection of Bridge Structural Health Monitoring Data

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Abstract

In past years, massive data has been accumulated by many bridge structural health monitoring systems, and various methods have been proposed to detect data anomalies to ensure the reliability of subsequent data analysis. However, these methods are incapable of determining if there still exist usable data segments in a data sequence providing a specified anomaly type has been identified. To address the problem, a deep learning-based multi-label classification method is proposed in this paper. A multi-label anomaly dataset is first constructed using monitored acceleration data of a cable-stayed bridge. Then, a multilabel anomaly classification model based on a convolutional neural network is developed and trained with the constructed dataset. The developed method exhibits desirable performance in simultaneously detecting the existence of both usable data and the other data anomalies.

Keywords: bridge; structural health monitoring; acceleration; data anomaly; deep learning; multilabel classification.

1 Introduction

Structural health monitoring (SHM) has been widely accepted as a promising means to ensure structural safety by analyzing accumulated monitoring data. However, the problem of data quality should be first examined to ensure the reliability of subsequent data analysis[1]. The problem of data quality is mainly induced by sensor faults, which could result in different types of data anomalies in measured data. Manually inspection and picking are feasible to avoid these data anomalies given limited data to be analyzed, however, the method becomes extremely inefficient in processing massive data. Therefore,

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